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# Efficacy of different chemical insecticides against pink bollworm *Pectinophora gossypiella* (Saund.) on Bt cotton in Maharashtra

**Dr. NK Bhute, Dr. RS Wagh, Dr. AK Kolage and NK Medhe**

**Abstract**
The present study was conducted at All India Coordinated Cotton Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, during *Kharif* 2018-19 under field condition. The results revealed that all the treatments of chemical insecticides were significantly superior over untreated control. The treatment with Chlorantraniliprole 18.5 SC @ 55 g a.i./ha was observed to be most effective against pink bollworm in which minimum pink bollworm larvae 3.67 /20 green bolls was observed. Similarly lowest percent green boll damage (11.33), open boll damage (21.33), locule damage (12.33) and highest seed cotton yield (20.05q/ha) was recoreded in the treatment Chlorantraniliprole 18.5 SC @ 55 g a.i./ha. This treatment was statistically on par with the treatments of λ-cyhalothrin 5EC @ 500 g.a.i./ha, thiodicarb 75 WP @ 750 g.a.i. and Profenophos 50 EC @ 750 g.a.i./ha. The data pertaining to effect of various insecticides on natural enemies viz. lady bird beetle, chrysopa and spiders in Bt cotton indicated highest number of natural enemies per plant were recorded in untreated control. The treatment with Chlorantraniliprole 18.5 SC @ 55 g a.i./ha was observed to be safer to the natural enemies in which higher number of natural enemies were observed. The results concluded that application of Chlorantraniliprole, has potential to obtain higher yield and net profit over remaining insecticides and also safer to natural enemies as its having green label.

**Keywords:** Efficacy, pink bollworm, *Pectinophora gossypiella*, Bt cotton, chemical insecticides

## Introduction
Cotton is a key fiber crop grown in more than seventy nations throughout the world. Cotton is a significant crop in the world's economic, political, and social concerns. It is popularly known as "White Gold" and "Friendly Fiber". India occupies 37.56% of world cotton area and produces 24.26% of world cotton production and stands tall. In India during 2019-20 the area, production and productivity of cotton were 125.84 lakh hectares, 360 lakh bales of 170 Kg and 486 Kg lint/ha respectively (Anonymous, 2020a) [5]. India earns foreign exchange to the tune of 12-14 bllion doller annually from exports of cotton yarn, thread, textiles, and apparels bring in between $12 and $14 billion in foreign exchange each year for India. India's domestic and international trade is projected to be worth (Rs. 15,000 crores) 30 US $ billion dollars every year (Anonymous, 2015) [4].

In India major cotton growing states are Maharashtra, Gujarat, Madhya Pradesh from central zone, Telangana, Andhra Pradesh, Karnataka and Tamil Nadu from south zone and Punjab, Haryana, Rajasthan from north zone. In Maharashtra during 2019-2020 the area, production and productivity of cotton were 43.69 lakh hectares, 82.00 lakh bales of 170 kg and 319 kg lint/ha, respectively (Anonymous, 2020b) [6].

Though there are several reasons that attributed to low yield, pest losses play a major role because cotton is paradise for an insect. A total of 1326 insect's species have been recorded on cotton (Kranti *et al*., 2005) [7]. In India, some 130 distinct species of insects and mites have been recorded to harm cotton crops (Agarwal *et al*., 1984) [2]. Pink bollworm *Pectinophora gossypiella* (Saunders) (Lepidoptera: Gelechidae) is a major cotton pest that burrows into cotton bolls to feed on the seed. Pink bollworm damages locules to the tune of 55 percent, with seed cotton yields ranging from 35 to 90 percent. The country lost 6525 metric tonnes of lint worth Rs 1216 million as a result of this pest (Agarwal and Katiyar, 1979) [1] and 2.81 to 61.87 percent reduction in seed cotton yield, 3.44 to 37.83 percent loss in germination, 2.12 to 47.13 percent loss in oil content and 10.66 to 59.15 percent loss in normal boll opening under unprotected conditions (Patil, 2003) [8].

Keeping these views, it is important to compare the efficacy of insecticides against pests for effective pest management and to reduce the indiscriminate use of insecticides. Thus, the present study was conducted to evaluate different insecticides against pink bollworm at AICCIP Rahuri, Dist. Ahmednagar (M.S.).

## Materials and Methods

### Experimental details

A field study was conducted to evaluate the different insecticides against pink bollworm, *P. gossypiella* during *kharif* 2018 under randomized block design (RBD) at All India Co-ordinated Cotton Improvement Project, Mahatma Phule Krishi Vidyapeeth Rahuri, Dist. Ahmednagar (M.S.) with nine treatments including an untreated control and were replicated thrice. A Popular Bt cotton hybrid Ajeet-199 was sown during *kharif* 2018 with a spacing of 90cm x 90cm in the plot size of 7.2m 5.4 m.

The incidence of pink bollworm were assessed from infested green bolls and based on pheromone trap catches ETL. The pheromone traps were placed at 30cm above the plant canopy and their height was adjusted periodically with the growth of the plants. The trap catch observations were made thrice in a week and at each observations moths of pink bollworms were counted and removed before taking next count. Pheromone lures were changed at 15 days interval.

Three insectide sprays were imposed at 15-20 days interval after crossing ETL based on pheromone trap catches and green boll damage ETL during the investigation period to know the efficacy of insecticides against pink bollworm. Low volume kanpsack sprayer was used with a spray fluid of 500 l/ha for foliar sprays. The pre-treatment count was taken before spraying for taking decision to initiate imposition of treatments and subsequently post treatment count were recorded after ten days of each spray application. The observations on rosette flowers, percent green boll damage through destructive boll sampling of green bolls, larval population per 20 green bolls, percent open boll damage and percent locule damage in open boll in each treatment were recorded at the time of harvesting. During the crop season, picking of seed cotton was done manually using human labour at the appropriate time without contamination of plant parts or trash. Individual plot seed cotton yields were recorded in separate pickings and expressed as quintal per ha. The data thus obtained was subjected to statistical analysis after using appropriate transformations. The percent rosette flowers, green boll damage, locule damage and open boll damage was worked out by using following formulas.

$$\text{Per cent Rosette flowers (\%)} = \frac{\text{No.of Rosette flowers}}{\text{Total No. of flowers}} \text{ X } 100$$

$$\text{Percent Green Boll Damage (\%)} = \frac{\text{No.of damaged green bolls}}{\text{Total No. of green bolls}} \text{ X } 100$$

$$\text{Percent Locule damage (\%)} = \frac{\text{No.of damaged locule}}{\text{Total No. of locule}} \text{ X } 100$$

$$\text{Per cent Open boll damage(\%)} = \frac{\text{No.of damaged bad open bolls}}{\text{Total No. of open bolls}} \text{ X } 100$$

**Table 1:** The details of insecticides used in bioefficacy against pink bollworm in Bt cotton

| Tr. No. | Insecticide treatment | Dose /ha | | Dose ml/10 litre | Trade Name | Source (Manf. /Marketing Company) |
|---|---|---|---|---|---|---|
| | | a.i. (gm)/ha | Formulation (ml or g/ha) | | | |
| $T_1$ | Profenophos 50 EC | 750 | 1500 ml | 30 ml | Curacron | Syngenta |
| $T_2$ | Thiodicarb 75 WP | 750 | 1000 g | 20 g | Larvin | Bayer |
| $T_3$ | Quinalphos 25 EC | 625 | 1000 ml | 20 ml | Ekalux | Syngenta |
| $T_4$ | Chloropyriphos 50 EC | 500 | 1000 ml | 20 ml | Predator | Dow |
| $T_5$ | Emamectin benzoate 5SG | 11 | 220 g | 4 g | Proclaim | Syngenta |
| $T_6$ | Lambda cyhalothrin 5 EC | 25 | 500 ml | 10 ml | Karate | Syngenta |
| $T_7$ | Cypermethrin 25 EC | 55 | 220 ml | 4 ml | Cymbush | Syngenta |
| $T_8$ | Chlorantraniliprole 18.5% SC | 30 | 150 ml | 3 ml | Coragen | Dupont |
| $T_9$ | Untreated control | -- | -- | -- | -- | -- |

## Results and Discussion

### Effect of insecticides on pink Bollworm larvae

The data on pink bollworm larvae/20 green bolls after first, second and third spray are presented in Table 2. The results observed the significant difference among the treatments studied in respect of pink bollworm larvae/20 green bolls after three sprays. The results revealed that all the treatments of chemical insecticides were significantly superior over untreated control. The treatment with Chlorantraniliprole 18.5 SC @ 55 g a.i./ha was observed to be most effective against pink bollworm in which minimum of 3.67 pink bollworm larvae/20 green bolls were observed. This treatment was statistically on par with the treatments of λ-cyhalothrin 5EC @ 500 g.a.i./ha, thiodicarb 75 WP @ 750 g.a.i. and Profenophos 50 EC @ 750 g.a.i./ha, in which 4.33 pink bollworm larvae/20 green bolls was noticed.

The results of the present investigations ae in accordence with findins of Govindan *et al.,* (2013) [14] who concluded that the chlorantraniliprole was the most suitable insecticides for control of pink bollworm larvae and less toxic to Natural enemies. The same opinion was also expressed by Sabry *et al*. (2014) [13] who reported that chlorantraniliprole 20% SC and spinetoram 12% SC were found effective in suppressing the pink bollworm larvae.

### Effect of insecticides on green boll damage by pink Bollworm

The observation on green boll damage by pink bollworm infestation after first, second and third spray are presented in Table 3. The three sprays mean results revealed the significant difference among the treatments studied in respect of green boll damage by pink bollworm.

The results observed that all the treatments of chemical insecticides were significantly superior over untreated control. The treatment with Chlorantraniliprole 18.5 SC @ 55 g a.i./ha was observed to be most effective against pink bollworm in which minimum of 11.33 percent green boll damage by PBW was observed. This treatment was statistically on par with the treatments of λ-cyhalothrin 5EC @ 500 g.a.i./ha, thiodicarb 75 WP @ 750 g.a.i. and Profenophos 50 EC @ 750 g.a.i./ha, in which 12.33, 12.67 and 14.67 percent green boll damage was noticed respectively.

The present findings are more or less parallel to Dhawan *et al.* (2009) who observed that chlorantranilipole 30 g a.i./ha had significantly lowest infestation of bollworm complex with minimum damage to floral shedding, boll damage, loculi damage as compared to the standard check insecticides namly the i. e deltamethrin, quinalpohs, chlorpyriphos and indoxacarb. Similar findings were also reported by Sarode AD *et al.* (2019) [12] reported that plot treated with chlorantraniliprole 18.5% SC recorded minimum percent fruiting body damage (3.50%) and which was at par with emamectin benzoate 5% SG (5.10%), spinosad 45% SC (5.64%) and thiodicarb 75% WP (6.05%).

**Effect of insecticides on Open boll damage and locule damage by pink Bollworm**

Th data pertaining to effect of various insecticides on Open boll damage and locule damage by pink Bollworm is depicted in Table 4. The overall mean of three sprays revealed that the treatment with Chlorantraniliprole 18.5 SC @ 55 g a.i./ha recorded open boll damage and locule damage of 21.33 and 12.33 percent, respectively and which was at par with λ-cyhalothrin 5EC @ 500 g.a.i./ha followed by thiodicarb 75 WP @ 750 g.a.i. and Profenophos 50 EC @ 750 g.a.i./ha. The next promising treatments in order of their efficacy were emamectin benzoate 5EC 11g.a.i./ha, chlorpyriphos 50 EC @ 500 g.a.i./ha and quinolphos 25EC @ 625g.a.i./ha.

The present findings are in accordence with Sarode *et al.* (2019) [12] who reported that the treatment of chlorantraniliprole 18.5% SC recorded minimum percent shed material (3.15%) Minimum locule damage (20.46%) is observed in the treatment with chlorantraniliprole 18.5% SC and this treatment was statistically at par with emamectin benzoate 5% SG (28.35%) and spinosad 45% SC (32.30%). The treatment with chlorantraniliprole 18.5% SC showed minimum percent of bad kapas (10.19%) and was statistically at par with emamectin benzoate 5% SG (11.34%), spinosad 45% SC (13.39%) and thiodicarb 75% WP (17.28%). The treatment with chlorantraniliprole 18.5% SC showed minimum percent seed damage (10.45%) and was statistically at par with emamectin benzoate 5% SG (13.43%) and spinosad 45% SC (18.20%). Similarly Sabry *et al*. (2014) [13] reported that chlorantraniliprole 20% SC and spinetoram 12% SC [13] were reported minimum locule damage and bad open bolls.

**Natural Enemies**

Data pertaining to effect of various insecticides on natural enemies viz. lady bird beetle, chrysopa and spiders in Bt cotton is depicted in Table 5. The data indicated highest number of 4.50 natural enemies/plant were recorded in untreated control. The treatment with Chlorantraniliprole 18.5 SC @ 55 g a.i./ha was observed to be safer to the natural enemies in which higher number of natural enemies 3.04/ plant were observed. The present findings are more or less parallel to Gavkare *et al.*, (2013) [15] who reported that chlorantraniliprole was safe to non-target insects (parasitoids, predators and pollinators) which supports the present results. Karthik *et al*., (2017) [16] concluded that cyantraniliprole 10% (w/v) OD found least effective against the spiders. Spiders' population in cotton ecosystem showed considerable decrease initially in all the treatments, it started increasing in later, support to present finding. Similar results were also observed by Humane *et al.,* who reported that the seven treatments, chlorantraniliprole 18.5% was found comparatively safer to natural enemies followed by cyantraniliprole 10% OD and Emamectin benzoate 5% SG, also Govindan *et al.,* (2013) [14] concluded that the chlorantraniliprole was the most suitable insecticides which was less toxic to Natural enemies.

**Impact on yield & economic returns**

The highest of seed cotton yield of 20.05 q/ha was recorded in the treatment with Chlorantraniliprole 18.5 SC @ 55 g a.i./ha. The next best treatments were thiodicarb 75 WP (18.39 q/ha), λ-cyhalothrin 5 EC (16.28 q/ha), Profenophos 50 EC (15.36q/ha), emamectin benzoate 5 EC (14.35 q/ha), chlorpyriphos 50 EC (12.36 q/ha) and quinolphos 25 EC (11.94 q/ha). However the untreated control plot recorded lowest seed cotton yield 8.84 q/ha. (Table 4). The cost of treatments obtained in treatments Chlorantraniliprole, thiodicarb, lambda cyhalothrin, and profenophos were rupees 7575, 11655, 3255 and 4875/ha respectively. The use of Chlorantraniliprole, thiodicarb, lambda cyhalothrin, and profenophos against pink bollworm were yielded higher benefits of Rs. 58895.5, 45834.9, 42819.8 and 36222.6/ha. The results conclude that application of Chlorantraniliprole, has potential to obtain higher net profit over remaining insecticides.

The maximum net return of Rs. 58895.5/ha was obtained in chlorantraniliprile with higher C:B ratio 1:2.30 (Table 6). The treatments thiodicarb, lambda cyhalothrin and profenophos recorded net return of Rs. 45834.9 /ha, Rs. 42819.8/ ha and 36222.6 /ha with C: B ratio 1:1.85, 1:1.95 and 1:1.77 respectively. The present findingds are more or less similar to Sarode *et al.* (2019) [12] who reported that the the highest seed cotton yield (12.46 q/ha) was recorded in the treatment with Chlorantraniliprole 18.5% SC. The highest ICBR (1: 14.51) was observed in the treatment cypermethrin 25% EC followed by Chlorantraniliprole 18.5% SC (1:12.31) and lambda cyhalothrin 5% EC (1:12.07).

**Table 2:** Pink bollworm larvae/20 green bolls

| Tr. No | Treatments | Dose a.i./ha | Precount | 1st spray | 2nd Spray | 3rd Spray | Mean |
|---|---|---|---|---|---|---|---|
| $T_1$ | Profenophos 50EC | 750 | 6.33 (2.61) | 4.54 (2.24) | 3.71 (2.05) | 4.74 (2.29) | 4.33 (2.97) |
| $T_2$ | Thiodicarb 75 WP | 750 | 7.00 (2.74) | 3.88 (2.09) | 4.83 (2.31) | 4.28 (2.19) | 4.33 (2.20) |
| $T_3$ | Quinalphos 25 EC | 625 | 9.33 (2.80) | 7.35 (2.80) | 6.67 (2.68) | 8.99 (3.08) | 7.67 (2.86) |
| $T_4$ | Chloropyriphos 50 EC | 500 | 8.00 (2.32) | 4.89 (2.32) | 5.03 (2.35) | 6.07 (2.56) | 5.33 (2.41) |
| $T_5$ | Emamectin benzoate 5SG | 11 | 6.67 (2.27) | 4.65 (2.27) | 4.45 (2.22) | 4.92 (2.33) | 4.67 (2.27) |
| $T_6$ | Lambda cyhalothrin 5 EC | 25 | 7.00 (2.19) | 4.31 (2.19) | 4.87 (2.32) | 3.81 (2.08) | 4.33 (2.12) |
| $T_7$ | Cypermethrin 25 EC | 55 | 8.33 (2.97) | 14.14 (3.83) | 17.57 (4.25) | 16.29 (4.10) | 16.00 (4.06) |
| $T_8$ | Chlorantraniliprole 18.5% SC | 30 | 8.00 (2.92) | 3.87 (2.09) | 3.72 (2.06) | 3.41 (1.98) | 3.67 (2.04) |
| $T_9$ | Untreated control | -- | 8.33 (2.97) | 18.62 (4.37) | 19.25 (4.44) | 21.14 (4.65) | 19.67 (4.49) |
| | SE ± | | 0.25 | 0.07 | 0.08 | 0.08 | 0.19 |
| | CD at 5% | | NS | 0.23 | 0.24 | 0.25 | 0.59 |
| | CV % | | 15.45 | 5.06 | 5.09 | 5.23 | 7.60 |

(Figures in parenthesis are √x+0.5 for numbers)

**Table 3:** Percent green boll damage by pink bollworm

| Tr. No | Treatments | Dose a.i./ha | Precount | 1st spray | 2nd Spray | 3rd Spray | Mean |
|---|---|---|---|---|---|---|---|
| $T_1$ | Profenophos 50EC | 750 | 13.01 (21.15) | 11.14 (19.50) | 17.20 (24.50) | 15.67 (23.32) | 14.67 (22.52) |
| $T_2$ | Thiodicarb 75 WP | 750 | 15.94 (23.53) | 10.48 (18.89) | 14.26 (22.19) | 13.27 (21.36) | 12.67 (20.85) |
| $T_3$ | Quinalphos 25 EC | 625 | 16.41 (23.90) | 14.57 (22.44) | 16.30 (23.81) | 28.14 (32.04) | 19.67 (26.33) |
| $T_4$ | Chloropyriphos 50 EC | 500 | 12.27 (20.50) | 17.27 (24.56) | 20.27 (26.76) | 17.45 (24.69) | 18.33 (25.35) |
| $T_5$ | Emamectin benzoate 5SG | 11 | 16.64 (24.07) | 24.01 (29.34) | 13.69 (21.71) | 11.29 (19.64) | 16.33 (23.84) |
| $T_6$ | Lambda cyhalothrin 5 EC | 25 | 9.61 (18.06) | 5.56 (13.04) | 17.20 (20.56) | 14.23 (22.16) | 12.33 (20.56) |
| $T_7$ | Cypermethrin 25 EC | 55 | 16.19 (23.73) | 17.64 (24.83) | 23.89 (29.26) | 22.46 (28.29) | 21.33 (27.51) |
| $T_8$ | Chlorantraniliprole 18.5% SC | 30 | 14.37 (22.28) | 10.97 (19.34) | 10.78 (19.17) | 12.24 (20.48) | 11.33 (19.67) |
| $T_9$ | Untreated control | -- | 15.44 (23.29) | 50.49 (45.28) | 56.89 (48.83) | 62.63 (52.32) | 56.67 (48.83) |
| | SE ± | | 2.51 | 1.22 | 1.33 | 1.42 | 2.18 |
| | CD at 5% | | NS | 3.71 | 4.04 | 4.31 | 6.60 |
| | CV % | | 19.16 | 8.18 | 8.80 | 9.63 | 14.52 |

(Figures in parenthesis are arcsine transformed values for percent)

**Table 4:** Percent open boll, locule damage by pink bollworm and yield

| Tr. No. | Treatments | Dose a.i./ha | Open boll damage | Locule damage | Yield q/ha |
|---|---|---|---|---|---|
| $T_1$ | Profenophos 50EC | 750 | 29.33 (32.79) | 16.67 (24.09) | 15.36 |
| $T_2$ | Thiodicarb 75 WP | 750 | 27.67 (31.73) | 15.68 (23.32) | 18.39 |
| $T_3$ | Quinalphos 25 EC | 625 | 32.33 (34.65) | 18.33 (25.35) | 11.94 |
| $T_4$ | Chloropyriphos 50 EC | 500 | 31.33 (34.04) | 17.67 (24.85) | 12.36 |
| $T_5$ | Emamectin benzoate 5SG | 11 | 30.33 (33.42) | 17.00 (24.35) | 14.35 |
| $T_6$ | Lambda cyhalothrin 5 EC | 25 | 26.33 (30.87) | 15.67 (23.32) | 16.28 |
| $T_7$ | Cypermethrin 25 EC | 55 | 33.67 (35.47) | 18.67 (25.60) | 11.85 |
| $T_8$ | Chlorantraniliprole 18.5% SC | 30 | 21.33 (27.51) | 12.33 (20.56) | 20.05 |
| $T_9$ | Untreated control | -- | 58.67 (49.99) | 36.33 (37.07) | 8.84 |
| | SE ± | | 1.42 | 1.12 | 0.09 |
| | CD at 5% | | 4.30 | 3.43 | 0.29 |
| | CV % | | 7.14 | 7.69 | 4.37 |

(Figures in parenthesis are arcsine transformed values for percent damage and *√x+0.5 for numbers)

**Table 5:** Effect of different insecticides on natural enemies (lady bird beetle, chrysopa & spider)

| Tr. No | Treatments | Dose a.i./ha | Precount | 1st spray | 2nd Spray | 3rd Spray | Mean |
|---|---|---|---|---|---|---|---|
| $T_1$ | Profenophos 50EC | 750 | 4.87 (2.32) | 4.20 (2.17) | 2.27 (1.66) | 2.29 (1.67) | 2.92 (1.85) |
| $T_2$ | Thiodicarb 75 WP | 750 | 5.07 (2.36) | 2.93 (1.85) | 2.33 (1.68) | 1.77 (1.51) | 2.34 (1.69) |
| $T_3$ | Quinalphos 25 EC | 625 | 4.60 (2.26) | 3.53 (2.01) | 2.80 (1.82) | 2.02 (1.59) | 2.78 (1.810) |
| $T_4$ | Chloropyriphos 50 EC | 500 | 5.27 (2.40) | 3.47 (1.99) | 3.33 (1.96) | 1.95 (1.57) | 2.92 (1.85) |
| $T_5$ | Emamectin benzoate 5SG | 11 | 4.93 (2.33) | 3.87 (2.09) | 2.93 (1.85) | 2.15 (1.63) | 2.98 (1.87) |
| $T_6$ | Lambda cyhalothrin 5 EC | 25 | 4.40 (2.21) | 4.00 (2.12) | 2.73 (1.80) | 2.11 (1.62) | 2.95 (1.86) |
| $T_7$ | Cypermethrin 25 EC | 55 | 4.20 (2.17) | 3.47 (1.99) | 3.13 (1.91) | 1.95 (1.57) | 2.85 (1.83) |
| $T_8$ | Chlorantraniliprole 18.5% SC | 30 | 4.60 (2.26) | 3.87 (2.09) | 3.13 (1.91) | 2.13 (1.62) | 3.04 (1.88) |
| $T_9$ | Untreated control | -- | 5.40 (2.43) | 5.13 (2.37) | 4.47 (2.23) | 3.91 (2.10) | 4.50 (2.24) |
| | SE ± | | 0.10 | 0.139 | 0.092 | 0.054 | 0.17 |
| | CD at 5% | | N/A | N/A | N/A | 0.163 | 0.51 |
| | CV % | | 7.61 | 11.68 | 8.65 | 5.76 | 9.67 |

(Figures in parenthesis are arcsine transformed values for percent damage and *√x+0.5 for numbers)

**Table 6:** Cost benefit ratio of different insecticides against cotton pink bollworms

| Sr. No. | Treatments | Dose /ha | Cost of insecticide/ha (Rs) | Labour cost (Rs) @ 290 | Treatment cost (Rs) | Cost of cultivation (Rs) | Total Cost (Rs) | Yield/ha (kg) | Gross income (Rs) 5410/q | Net income (Rs | Income difference | BCR | ICBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Profenophos 50EC | 1500 ml | 2700 | 2175 | 4875 | 42000 | 46875 | 15.36 | 83097.6 | 36222.6 | 30398.2 | 1.77 | 6.24 |
| 2 | Thiodicarb 75 WP | 1000 g | 9480 | 2175 | 11655 | 42000 | 53655 | 18.39 | 99489.9 | 45834.9 | 40010.5 | 1.85 | 3.43 |
| 3 | Quinalphos 25 EC | 1000 ml | 1113 | 2175 | 3288 | 42000 | 45288 | 11.94 | 64595.4 | 19307.4 | 13483 | 1.43 | 4.10 |
| 4 | Chloropyriphos 50 EC | 1000 ml | 870 | 2175 | 3045 | 42000 | 45045 | 12.36 | 66867.6 | 21822.6 | 15998.2 | 1.48 | 5.25 |
| 5 | Emamectin benzoate 5SG | 220 g | 1650 | 2175 | 3825 | 42000 | 45825 | 14.35 | 77633.5 | 31808.5 | 25984.1 | 1.69 | 6.79 |
| 6 | Lambda cyhalothrin 5 EC | 500 ml | 1080 | 2175 | 3255 | 42000 | 45255 | 16.28 | 88074.8 | 42819.8 | 36995.4 | 1.95 | 11.37 |
| 7 | Cypermethrin 25 EC | 220 ml | 185 | 2175 | 2360 | 42000 | 44360 | 11.85 | 64108.5 | 19748.5 | 13924.1 | 1.45 | 5.90 |
| 8 | Chlorantraniliprole 18.5% SC | 150 ml | 5400 | 2175 | 7575 | 42000 | 49575 | 20.05 | 108471 | 58895.5 | 53071.1 | 2.19 | 7.01 |
| 9 | Untreated control | 0 | 0 | 0 | 0 | 42000 | 42000 | 8.84 | 47824.4 | 5824.4 | 0 | 1.14 | 0.00 |

Selling price of seed cotton: Rs. 5410 /q, Labour charges: Rs. 290/day. MRP: Profenophos: Rs. 600/lit, Thiodicarb 75 WP Rs. 3160/lit., Quinalphos 25 EC: Rs. 371/lit, Chloropyriphos 50 EC Rs. 290/ lit, Lambda cyhalothrin: Rs. 720/lit., Emamectin benzoate 5SG Rs. 2500/kg, Cypermethrin 25 EC Rs. 280/lit., Chlorantraniliprole 18.5% SC Rs. 1800/150 ml.

## Conclusion

Evaluation of different insecticides against pink bollworm in Bt cotton indicated that all the insecticides were found significantly superior over untreated control. The results indicated that among all insecticides the chlorantraniliprole 18.5 SC found most effective for control of rosette flower, green boll damage, larval population, open boll damage and locule damage. Similarly it was at par with the insecticides thiodicarb 75 WP, lambda cyhalothrin 5 EC profenophos 50 EC and emamectin benzoate 5 SG. The results recorded in this study is useful in pink bollworm management.

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